

1.A.4.b ii - Residential: Household and Gardening: Mobile

Short description

Under sub-category *1.A.4.b ii - Residential: Mobile Sources in Households and Gardening* fuel combustion activities and resulting emissions from combustion engine driven devices such as motor saws and lawn mowers are being reported.

Method	AD	EF	Key Category Analysis
T1	NS, M	CS, D	L/T: CO

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Methodology

Activity data

Activity data are taken from annual fuel deliveries data provided in line 66: 'Households' of the National Energy Balances (NEB) for Germany (AGEB, 2019) ¹⁾.

Table 1: Sources for consumption data in 1.A.4.b ii

Relevant years	Data Source
through 1994	AGEB - National Energy Balance, line 79: Households
since 1995	AGEB - National Energy Balance, line 66: Households

Here, given the rare statistics on sold machinery, these activity data is of limited quality only (no annual but cascaded trend).

As the NEB only provides primary activity data for *total biomass* used in 'households', but does not distinguish into specific biofuels, consumption data for bioethanol used in NFR 1.A.4.b ii are calculated by applying Germany's official annual shares of biogasoline blended to fossil gasoline.

Please note: *Data on gasoline used in households* as provided in the National Energy Balances represents a "residual item" following the allocation of the majority of this fuel to road and military vehicles. Here, fuel sales to road vehicles might also include gasoline acquired on filling stations but used for household equipment.

Due to these reasons, activity data for gasoline consumption in households machinery and, hence, several emission estimates *show no realistic trend but a stepwise development* with significant jumps.

Table 2: Annual over-all fuel deliveries to residential mobile sources, in terajoules

	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
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[illegible]

source: AGEb, 2019 ²⁾ and TREMOD MM ³⁾

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These primary activity data can be distributed onto 2- and 4-stroke engines used in households via annual shares from Knörr et al. (2019b) ⁴⁾.

Table 3: Annual shares of 2- and 4-stroke engines

[illegible]

source: TREMOD MM ⁵⁾

Table 4: Resulting estimates for fuel consumption in 2- and 4-stroke engines, in terajoules

[illegible]

Emission factors

The emission factors used here are of rather different quality: For all **main pollutants, carbon monoxide** and **particulate matter**, annually changing values computed within TREMOD-MM (Knörr et al. (2019b)) ⁶⁾ are used, representing the development of mitigation technologies and the effect of fuel-quality legislation.

Here, as no such specific EF are available for biofuels, the values used for gasoline are applied to bioethanol, too.

For lead (Pb) from leaded gasoline and corresponding TSP emissions, additional emissions are calculated from 1990 to 1997 based upon country-specific emission factors from ⁷⁾.)

Table 5: Annual country-specific emission factors from TREMOD MM¹, in kg/TJ

[illegible]

NOTE: For the country-specific emission factors applied for particulate matter, no clear indication is available, whether or not condensables are included.

[!- Table 6: Tier1 emission factors for heavy-metal and POP exhaust emissions from fuel combustion and engine wear

[illegible]

trend basically following the decline in fuel consumption between 2000 and 2005. Nonetheless, the decrease of the over-all emission trend was and still is amplified by the expanding use of particle filters especially to eliminate soot emissions.

Additional contributors such as the impact of TSP emissions from the use of leaded gasoline (until 1997) have no significant effect onto over-all emission estimates.

Here, as the EF(BC) are estimated via fractions provided in ¹⁰⁾, black carbon emissions follow the corresponding emissions of PM_{2.5}.

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+ Recalculations

As all **emission factors** remain unchanged, recalculations occur only for 2017, resulting from the application of **activity data** from the now finalised National Energy Balance 2017.

Table 7: Revised total inland fuel deliveries 2017 for household-related consumption, in terajoules

=			= gasoline			= biogasoline
	= total	= 2-stroke	= 4-stroke	= total	= 2-stroke	= 4-stroke
~ Submission 2020	> 4,228	> 1.010	> 3,218	> 178	> 42.6	> 135.7
~ Submission 2019	> 4,228	> 1.010	> 3,218	> 180	> 43.0	> 137.0
~ absolute change	> 0	> 0	> 0	> -2	> -0.4	> -1.3
~ relative change	> 0.00%	> 0.00%	> 0.00%	> -0.96%	> -0.98%	> -0.96%

For specific **information on recalculated emission estimates for Base Year and 2017**, please see the pollutant specific recalculation tables following chapter [8.1 - Recalculations](#).

+ Uncertainties

Uncertainty estimates for **activity data** of mobile sources derive from research project FKZ 360 16 023 (Knörr et al. (2009)) ¹¹⁾: "Ermittlung der Unsicherheiten der mit den Modellen TREMOD und TREMOD-MM berechneten Luftschadstoffemissionen des landgebundenen Verkehrs in Deutschland".

Uncertainty estimates for **emission factors** were compiled during the PAREST research project. Here, the final report has not yet been published.

+ Planned improvements

Besides a **routine revision** of the **TREMOD MM** model, no specific improvements are planned at the moment.

+ FAQs

Why are similar EF applied for estimating exhaust heavy metal emissions from both fossil and biofuels?

The EF provided in ¹²⁾ represent summatory values for (i) the fuel's and (ii) the lubricant's heavy-metal content as well as (iii) engine wear. Here, there might be no heavy metal contained in biofuels. But since the specific shares of (i), (ii) and (iii) cannot be separated, and since the contributions of lubricant and engine wear might be dominant, the same emission factors are applied to biodiesel and

bioethanol.

bibliography : 1 : AGEb, 2019: Working Group on Energy Balances (Arbeitsgemeinschaft Energiebilanzen (Hrsg.), AGEb): Energiebilanz für die Bundesrepublik Deutschland; URL: <http://www.ag-energiebilanzen.de/7-0-Bilanzen-1990-2017.html>, (Aufruf: 29.10.2019), Köln & Berlin, 2019. : 2 : Knörr et al. (2019b): Knörr, W., Heidt, C., Gores, S., & Bergk, F.: ifeu Institute for Energy and Environmental Research (Institut für Energie- und Umweltforschung Heidelberg gGmbH, ifeu): Aktualisierung des Modells TREMOD-Mobile Machinery (TREMOD MM) 2019, Heidelberg, 2019. : 3 : EMEP/EEA, 2019: EMEP/EEA air pollutant emission inventory guidebook – 2019, Copenhagen, 2019. : 4 : Rentz et al., 2008: Nationaler Durchführungsplan unter dem Stockholmer Abkommen zu persistenten organischen Schadstoffen (POPs), im Auftrag des Umweltbundesamtes, FKZ 205 67 444, UBA Texte | 01/2008, January 2008 - URL: <http://www.umweltbundesamt.de/en/publikationen/nationaler-durchfuehrungsplan-unter-stockholmer> : 5 : Knörr et al. (2009): Knörr, W., Heldstab, J., & Kasser, F.: Ermittlung der Unsicherheiten der mit den Modellen TREMOD und TREMOD-MM berechneten Luftschadstoffemissionen des landgebundenen Verkehrs in Deutschland; final report; URL: <https://www.umweltbundesamt.de/sites/default/files/medien/461/publikationen/3937.pdf>, FKZ 360 16 023, Heidelberg & Zürich, 2009. **bibliography**

¹⁾ (bibcite 1)

²⁾ (bibcite 1)

³⁾ (bibcite 2)

⁴⁾ (bibcite 2)

⁵⁾ (bibcite 2)

⁶⁾ (bibcite 2)

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⁹⁾ (bibcite 5)

¹⁰⁾ (bibcite 3)

¹¹⁾ (bibcite 5)

¹²⁾ (bibcite 4)